

Spixiana	3	2	157-166	München, 1. Juli 1980	ISSN 0341-8391
----------	---	---	---------	-----------------------	----------------

# Seasonal Shifts in the Pattern of Habitat Utilization by the Spotted Deer (*Axis axis* Erxleben 1777) in the Ruhuna National Park, Sri Lanka

(Mammalia, Cervidae)

By

**S. Balasubramaniam**

Department of Botany, University of Peradeniya, Sri Lanka

**Charles Santiapillai**

Department of Zoology, University of Peradeniya, Sri Lanka

**M. R. Chambers**

Department of Zoology, University of Colombo, Sri Lanka

## Abstract

Observations on the populations of Spotted deer (*Axis axis*) resident in the Ruhuna National Park, Sri Lanka were made seasonally to assess the pattern of habitat utilization. A marked seasonal variation in the diet and habitat preference was observed. In the dry season, most of the deer were associated with the forest/scrub habitats in small groups while in the wet season, the majority of the deer were seen in large groups in the plains. In the dry season deer were observed browsing on shrubs and trees while during the wet season their grazing activities were enhanced. Microscopical examination of the faecal pellets collected from the two seasons showed more abundant grass epidermal fragments in the wet season than in the dry season. Herd size was found to be small in the forest/scrub habitats and large in the plains.

## Introduction

The Spotted deer (*Axis axis*) in Sri Lanka is typically an inhabitant of low country scrub forests in the dry zone. Although widespread throughout the island up to an altitude of 500 m (STOREY 1907) at one time, its numbers have declined through the activities of sportsmen and poachers and also owing to the destruction of its preferred habitats for agricultural development. Today, it is confined almost entirely to the National Parks and other sanctuaries.

The Spotted deer shares these Parks and sanctuaries with a variety of herbivores such as elephant (*Elephas maximus*), water buffalo (*Bubalus bubalis*), wild boar (*Sus scrofa*),

sambar (*Cervus unicolor*), barking deer or muntjac (*Muntiacus muntjak*), mouse deer (*Tragulus meminna*) and the black-naped hare (*Lepus nigricollis*). The members of this herbivore community have evolved different feeding strategies and behaviour patterns that to some extent reduce the competition between them (EISENBERG & LOCKHART 1972).

The Spotted deer, elephant and water buffalo form the bulk of the herbivore biomass in Sri Lankan National Parks. This study on the Spotted deer was undertaken to provide information on its seasonal shifts in habitat and feeding preferences. Such information is required as an aid to the formulation of management policies that are geared to the maintenance of habitats suitable for the herbivore community as a whole.

### Study Area

Sri Lanka (Ceylon) is a large island (65,580 km<sup>2</sup>) situated in the Indian Ocean off the southern tip of India between latitudes N5°54' and 9°52' and longitudes E79°39' and 81°53'. Ruhuna National Park is situated in the extreme south-east corner of the island (Fig. 1) in the low country dry zone. This is a large Park (1,160 km<sup>2</sup>) divided into several areas. The studies were carried out in block I (Fig. 2), that part of the Park which is most accessible and to which all visitors are confined. It is approximately 140 km<sup>2</sup> in extent.

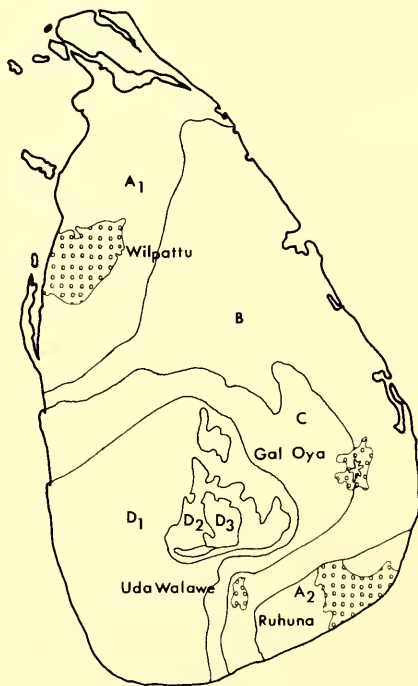


Fig. 1: Sri Lanka (Ceylon) showing the position of the four National Parks.

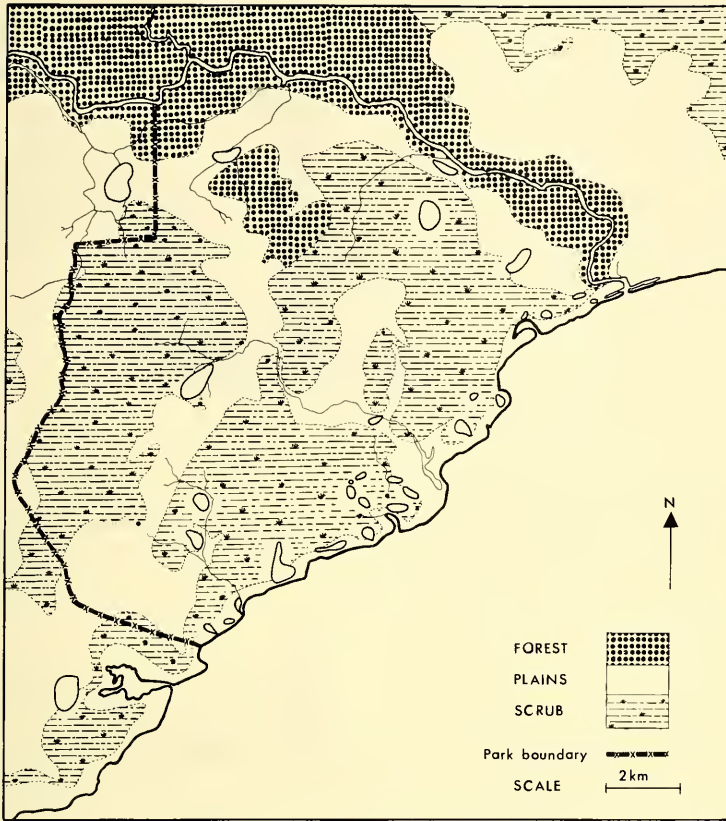


Fig. 2: Ruhuna National Park (block I) which constituted the main study area.

The river Menik ganga forms the northern boundary of the block I while the south and south-eastern border is formed by the Indian Ocean. The fields of now abandoned (chena) cultivation form the western boundary.

Ruhuna National Park is situated in the low country dry zone. The climate is strongly seasonal with an annual rainfall of about 1000 mm. Much of this rain falls from October to January during the north-east monsoon. There is a less intense rainy season from March to April/May and a pronounced dry season from May/June to September. During the peak of the drought, the Park receives less than 10 mm of rain per month. During the rainy season, water is freely available everywhere and many lakes (villus), ponds and water holes readily form as drainage is impeded by the clayey nature of the subsoil. At the height of the drought however, only the largest villus retain any water and the river Menik ganga gets reduced to a series of small water holes.

The vegetation in the Park has been classified by MUELLER-DOMBOIS (1968) as falling into three physiognomic categories: – (a) forest (with at least 20% of crown biomass

above 5 m in height), (b) scrub (less than 20% of crown biomass above 5 m) and (c) grassland or plains. The dominant forest trees are *Manilkara hexandra*, *Drypetes sepiaria* in well drained soil and *Feronia limonia* and *Salvadora persica* in poorly drained areas. In the scrub vegetation, some of the common shrubs and treelets are *Capparis sepiaria*, *C. zeylanica*, *Dichrostachys cinerea*, *Flueggea virosa*, *Randia dumentorum* and *Cratava religiosa*. The main components of the grassy plains are *Eragrostis viscosa*, *Dactyloctenium aegyptium*, *Sporobolus diandrus*, *Echinochloa colonum*, *Setaria pallidifusca* and *Aloteropsis cimicina*. These vegetation types form a mosaic throughout block I though most of the grassland areas are confined to the eastern coastal region while the forest and scrub predominate in the central and western areas.

## Methods

Observations on the Spotted deer were made in July/August 1978 (dry season) and the beginning and end of December 1978 (wet season).

During both seasons, regular surveys were made of forest, scrub and grassland (plains) habitats and the following information collected: - size of all groups encountered, the habitat type, feeding behaviour and the names of all plants seen to be eaten by the deer. In addition, during the dry season, more intensive studies were carried out around some of the permanent water holes where the deer emerge from the surrounding forest/scrub to drink.

SCHALLER (1967) in his studies on the Indian Chital (*Axis axis*) regarded a herd as any aggregation of two or more individuals. As for the deer in the Ruhuna National Park, it was decided to consider any aggregation of three or more individuals as constituting a herd on the basis of the most cohesive social unit that was observed in the Park. The most cohesive social unit of deer seems to be that of the adult female, her fawn and perhaps the young from the previous litter. Thus the calculation of herd size would be based on a lower total of deer observed than in the case of group size.

All deer sightings could be assigned to either the boundaries of forest and scrub or grassland (plains).

## Results

### Habitat preference

Figs. 3 & 4 illustrate the frequency of the group sizes from forest/scrub and grassland (plains) habitats in the dry season and the wet season respectively. In total more than 3000 deer were recorded in the two seasons.

From fig. 3 it appears that in the dry season most deer were associated with forest/scrub habitats as more groups were observed here than in the plains. The most frequently occurring group size at this time in the forest/scrub is 10-20 animals whilst the next most common group is that of solitary animals (mostly adult males). Group sizes of more than 20 animals probably represent the fusion of several smaller groups during periods of drinking at the villus or water holes. In the plains, during July/August the most commonly occurring group size is also 10-20 animals.

In the December wet season (Fig. 4) most groups of Spotted deer were seen in the plains. At this time, large groups of deer (up to 140 animals) gather in these regions and

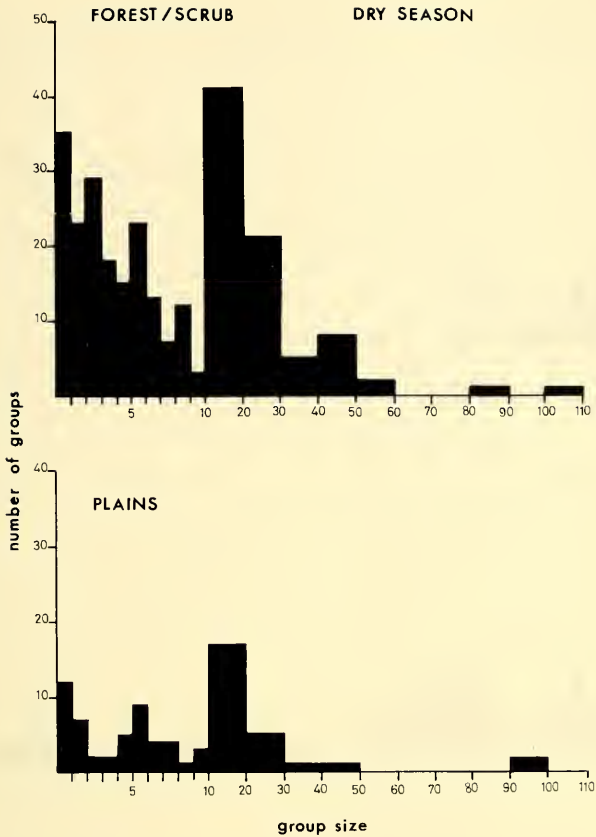


Fig. 3: Frequency diagrams indicating group size for Spotted deer (*Axis axis*) utilizing the forest/scrub and plains habitats in the dry season in the Ruhuna National Park, Sri Lanka.

the most common group sizes were of 4 and from 10–20 individuals. In the forest/scrub at this time there were much fewer groups encountered and the most commonly occurring group sizes were of solitary animals and of 10 animals.

Thus these findings indicate a marked seasonal variation in habitat preference. In the July/August dry season the Spotted deer are mainly to be found in the forest/scrub habitats where they feed predominantly on the browse plants. The plains are avoided to a greater extent as most of the short grass communities are dead. During the December wet season however, most of the deer are observed on the open plains, where there is an emphasis on grazing rather than browsing. Thus the seasonal differences in the dispersion of deer observed in the Park are manifestations of the seasonal variations in their patterns of habitat utilization.

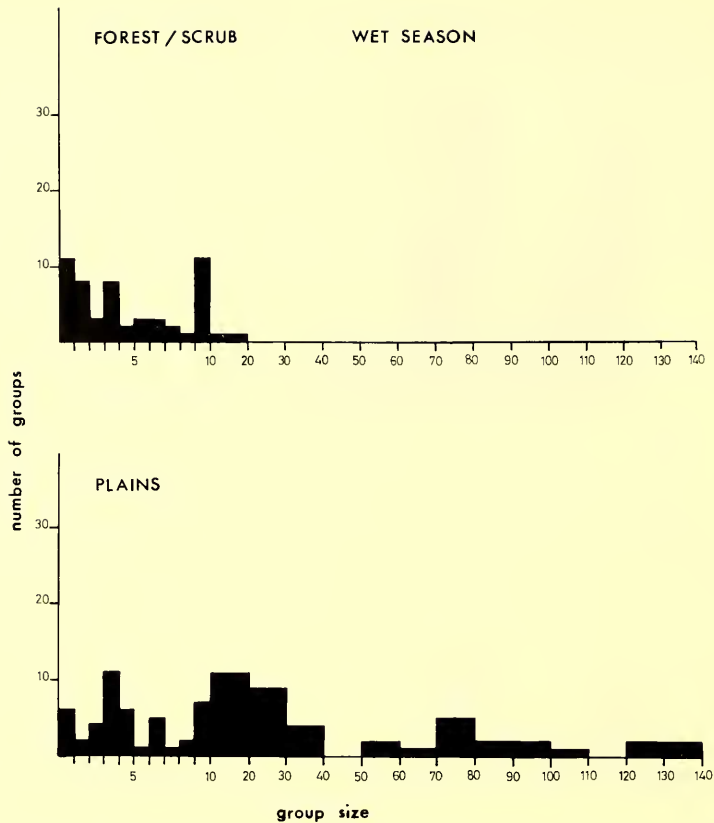


Fig. 4: Frequency diagrams indicating group size for Spotted deer (*Axis axis*) utilizing the forest/scrub and plains habitats in the wet season in the Ruhuna National Park, Sri Lanka.

### Food preference

Table 1 shows the plants that the Spotted deer were observed to feed on. It is apparent that there is a clear difference between the preferred food items from the dry season and the wet season.

In the dry season, the deer browse predominantly on shrubs and trees and to a much lesser extent feed on grasses. In the wet season however, grazing on grasses and herbaceous plants is the norm whilst browsing on trees and shrubs becomes much less common.

Not all plants are taken equally in the various seasons. Of the 21 species recorded as being eaten in the dry season, *Flueggea leucopyrus*, *Capparis sepriaria*, *C. zeylanica*, *Carissa spinarum*, *Crateva religiosa* and *Terminalia arjuna* are most intensely browsed than the others. During the wet season it is more difficult to determine the preferred species (if any) of grasses and herbs as they form a single, mixed community.



Table 1: Seasonal changes in the diet preference of the Spotted deer (*Axis axis*) in the Ruhuna National Park, Sri Lanka.

category	species	family	season	
			dry	wet
grass	<i>Eragrostis viscosa</i>	Gramineae	+	+
	<i>Dactyloctenium aegyptium</i>	Gramineae	+	+
	<i>Sporobolus diandrus</i>	Gramineae	+	+
	<i>Alloteropsis cimicina</i>	Gramineae	+	+
	<i>Echinochloa colonum</i>	Gramineae		+
	<i>Setaria pallidifusca</i>	Gramineae		+
	<i>Cyanodon dactylon</i>	Gramineae		+
	<i>Panicum sp.</i>	Gramineae		+
	<i>Auxonopus sp.</i>	Gramineae		+
	sedge	<i>Cyperus iria</i>	Cyperaceae	
<i>Tephrosia purpurea</i>		Leguminosae		+
legume	<i>Zornia diphylla</i>	Leguminosae		+
	<i>Desmodium triflorum</i>	Leguminosae		+
herb	<i>Spermococe hispida</i>	Rubiaceae		+
	<i>Corchorus tridens</i>	Tiliaceae		+
	<i>Cyanotis axillaris</i>	Commelinaceae		+
	<i>Aneilema spiratum</i>	Commelinaceae		+
	<i>Rungia repens</i>	Acanthaceae		+
thorny	<i>Flueggea leucopyrus</i>	Euphorbiaceae	+	
	<i>Capparis sepriaria</i>	Euphorbiaceae	+	
shrub	<i>Azima tetracantha</i>	Salvadoraceae	+	
	<i>Carissa spinarum</i>	Apocyanaceae	+	
shrub	<i>Lantana camara</i>	Verbenaceae		+
	<i>Memecylon umbellatum</i>	Melastomataceae	+	
	<i>Cassia auriculata</i>	Leguminosae	+	
tree	<i>Salvadora persica</i>	Salvadoraceae	+	+
	<i>Crateva religiosa</i>	Capparidaceae	+	+
	<i>Capparis zeylanica</i>	Capparidaceae	+	
	<i>Feronia limonia</i>	Rutaceae	+	+
	<i>Atalantia monophylla</i>	Rutaceae	+	
	<i>Drypetes sepriaria</i>	Euphorbiaceae	+	
	<i>Euphorbia antiquorum</i>	Euphorbiaceae	+	
	<i>Mischodon zeylanica</i>	Euphorbiaceae	+	
	<i>Sapindus emarginatus</i>	Sapindaceae	+	
	<i>Aglaia roxburghiana</i>	Meliaceae	+	
<i>Terminalia arjuna</i>	Combretaceae	+		

Faecal pellets of the Spotted deer were collected from both the dry and wet seasons and were subjected to faecal analysis by the method outlined by DUNNET, HARVIE & SMIT (1973). Microscopical examination of the faecal pellets revealed a preponderance of grass epidermal fragments in the wet season than in the dry season samples.

In total, Spotted deer were observed to feed on 36 species of plants.

#### Herd size

From table 2 it appears that the herd size remains consistently larger in the plains than in the forest/scrub habitats both during the wet and dry seasons. While the average herd size of deer in the forest/scrub habitats dropped from 11.65 in the dry season to 6.90 in the wet season that of the deer in the plains more than doubled.

In general, animals living on open areas are found in larger groups or herds than those living in forested areas (DASMAN & TABER 1956, PEEK et al. 1974, FRANKLIN et al., 1975). This was found to be so in the case of the Spotted deer in the Ruhuna National Park.

### Discussion

It is clear that the habitat preferences and feeding behaviour of the Spotted deer show seasonal changes.

These shifts are to a great extent imposed upon the deer by seasonal changes in the plant communities themselves. During the July/August drought, standing water is restricted to a few of the major villus or water holes, the surface soils dry out and all the grass and herbaceous vegetation on the plains die off. These dead plants are insufficient in quantity and quality to maintain the deer, which are then compelled to concentrate in the forest/scrub areas for both water and food.

In the forest/scrub areas, the deer resort to browsing on the leaves of evergreen trees and can also find some plants to graze in the more moist conditions prevailing in these habitats.

With the onset of the rains in October water is again freely available and the plants in the plains grow rapidly. At this time, the deer disperse widely through the Park. Many return to the plains and graze on the now abundant vegetation there. Some remain in the forest/scrub areas, feeding on both the newly flushed leaves of trees and also grazing on vegetation within the forest and surrounding the water holes.

Between the beginning and end of December a difference was also noted in the dispersion of the deer. At the beginning of the month, large numbers of deer congregated on the plains and their average herd size was 45.11 (table 2). By the end of the month fewer deer were found here and the herd size had declined to 26.79.

The reason for this is not clear but it could be due to one or a combination of several factors. Between the two December censusing periods there was heavy and prolonged rainfall. This caused the villus or water holes to greatly increase in size and much of the remaining plains became marshy. Thus the amount of available grassland became less, perhaps reducing the numbers of deer that could be supported. In addition, the deer may actively avoid marshy areas and return to drier areas of forest/scrub. Thirdly, the approach of the main parturition period may compel the pregnant hinds to seek seclusion in



Table 2: Seasonal changes in the herd size of Spotted deer (*Axis axis*) in the forest/scrub habitats and plains in the Ruhuna National Park, Sri Lanka.

season	time	habitat	no. of herds tallied	average herd size	largest herd size	total no. classified
dry	Jul/Aug 1978	forest/scrub	246	11.65	108	2866
		plains	66	13.00	98	858
wet	Dec. 1st week 1978	forest/scrub	19	9.68	18	184
		plains	35	45.11	146	1579
	Dec. 4th week 1978	forest/scrub	30	6.90	13	207
		plains	57	26.79	136	1527

the forest/scrub. The large quantities of fresh vegetation available from October onwards ensure that pregnant hinds obtain a high plane of nutrition essential for the development of the foetus.

Herd size could be influenced by a variety of factors. Most important is the availability of water and food (SCHALLER 1967). Variations in group or herd size could also be due to changes in weather (GOSSOW 1971), to season (MCKAY & EISENBERG 1971) and food availability (ALTMANN 1956).

The vegetation of Ruhuna National Park forms a mosaic of the three major types – forest, scrub, and grasslands or plains, with several intermediate types. The climatic climax vegetation of the area is semi-deciduous forest which by over-exploitation becomes degraded into dense scrub thickets. The plains are probably an adaphic climax maintained by grazing pressure and periodic flooding and impeded drainage.

The role that the grazing animals, particularly elephant, water buffalo and spotted deer play in maintaining this pattern of communities is unknown. It is also not known whether the proportion of the various vegetation types in the Park is constant or whether slow, imperceptible successional changes are leading to some alterations in the communities.

Management policies of the Park should ensure the maintenance of a wide variety of habitat types, with special care being taken to ensure that large areas of grassland do not revert to scrub or forest. Recent weed introductions may also lead to changes in the composition of the grasslands and cleared areas. Unfortunately, it is not known what the ideal ratio of the major habitat types should be that is required for the proper maintenance of the rich and diverse herbivore community of the Ruhuna National Park.

## Acknowledgments

We wish to thank Professor K. D. Arudpragasam, Department of Zoology, University of Colombo, Sri Lanka and Professor G. M. Dunnet, Department of Zoology, University of Aberdeen, UK for inviting us to take part in the joint Aberdeen and Colombo Universities Research Programme. This study was made possible through their joint efforts. Our thanks to Professor H. Cruz, Department of Zoology, University of Peradeniya, Sri Lanka for his help and encouragement.

We extend our grateful thanks to the Director of Sri Lanka Department of Wildlife Conservation, Mr. Lyn de Alwis, and the Warden of the Ruhuna National Park, Mr. Childers Jayawardena, for their generous help and assistance in the field. We thank Mr. Tissa Alagoda of the Department of Zoology of Peradeniya for his technical assistance.

## References

- ALTMANN, M. 1956: Patterns of social behaviour in big game. – Transactions of the North American Wildlife Conference. 21: 538–544
- DASMANN, R. F. & TABER, R. D. 1956: Behaviour of Columbian black-tailed deer with reference to population ecology. – J. Mammalogy. 37: 143–164
- DUNNET, G. M., HARVIE, A. E. & SMIT, T. J. 1973: Estimating the proportions of various leaves in the diet of the opossum, *Trichosurus vulpecula* Kerr, by faecal analysis. – J. appl. Ecol. 10: 737–745
- EISENBERG, J. F. & LOCKHART, M. 1972: An Ecological Reconnaissance of the Wilpattu National Park, Ceylon. – Smithsonian Contrib. Zool. 101. Washington DC, Smithsonian Institution Press.
- FRANKLIN, W. L., MOSSMAN, A. S. & DOLE, M. 1975: Social organization and home range of Roosevelt elk. – J. Mammalogy. 56: 102–118
- GOSSOW, H. 1971: Soziologische und Rangordnungsaspekte bei einer alpinen Rotwildpopulation. – Allg. Forst- u. Jagdztg. 142: 169–173
- MCKAY, G. M. & EISENBERG, J. F. 1971: Movement patterns and habitat utilization of ungulates in Ceylon. – In: The Behaviour of Ungulates and its relation to Management. IUCN Paper 39: 708–721
- MUELLER-DOMBOIS, D. 1968: Ecogeographic analysis of a climate map of Ceylon with particular reference to vegetation. – Ceylon Forester. 8 (3/4): 39–58
- PEEK, J. M., LERESCHE, R. E. & STEVENS, D. R. 1974: Dynamics of moose aggregations in Alaska, Minnesota and Montana. – J. Mammalogy. 55: 126–137
- SCHALLER, G. B. 1967: The deer and the tiger. The University of Chicago Press, Chicago.
- STOREY, H. 1907: Hunting and shooting in Ceylon. London.

Addresses of the authors:

Dr. S. Balasubramaniam, Department of Botany, University of Peradeniya, Sri Lanka  
Dr. Ch. Santiapillai, Department of Zoology, University of Peradeniya, Sri Lanka  
Dr. M. R. Chambers, Department of Zoology, University of Colombo, Sri Lanka

Angenommen am 20. 3. 1980